

HEALTH AND HUMAN SCIENCES

Analysis of Manganese Accumulation in the Pituitary Gland and Hippocampus of Smelters Using High Resolution 3-D T1-Weighted MRI

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Chronic exposure to excessive manganese (Mn) has neurotoxic effects, which can lead to behavioral and motor deficits. Overexposure to Mn may occur in the smelting and welding industries, and previous studies have found significant Mn accumulation in the basal ganglia of exposed populations using Magnetic Resonance Imaging (MRI). MRI can identify Mn accumulation in the brain because Mn acts as a contrast agent, increasing the signal in T1-weighted images. This study investigates brain Mn accumulation in the pituitary gland and hippocampus.

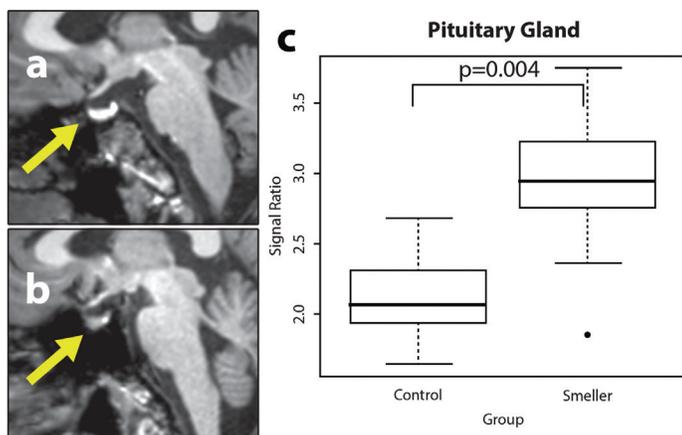
High-resolution 3-D T1-weighted images from a former study on 10 Mn ore smelters and 10 controls with no history of exposure were analyzed. 3-D volumes of interest (VOI) were placed in the pituitary gland and right and left hippocampi. A separate VOI was placed in the neck muscle as an internal reference. The relative signal intensity for each region was determined by calculating the ratio of the brain region to the neck, which represents the relative Mn accumulation in that region. Group differences were tested using linear regression.

A significant increase in the signal ratio was found in smelters compared to controls in only the pituitary gland ($p = 0.004$). There was no statistically significant difference between smelters and controls in the hippocampus. These results are consistent with previous studies that have identified the pituitary gland as a region where Mn accumulates in nonhuman primates. This study is the first study to demonstrate elevated Mn accumulation in the pituitary gland in humans exposed to Mn.

Acknowledgments:

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Research advisors Ulrike Dydak, Mark Ward, and Eric Cameron write: “Zeinab, Molly, and Alison analyzed MRI images for elevated manganese deposition in brain areas not investigated to date. Their discovery of significant changes in the pituitary gland of smelting workers is of high interest to the understanding of Mn toxicity, and will be presented at the International Congress of Toxicology.”



Example of images of 3-D T1-weighted high-resolution MRI images depicting (a) the pituitary gland of a smelter with high signal intensity and (b) a control subject without hyperintensity in the pituitary gland. (c) Group-wise plot of signal ratio of the pituitary gland.